

What is claimed is:

1 1. An apparatus, comprising:
2 a first part including a bore;
3 an eccentric sleeve mounted in said bore of said first part, said eccentric sleeve including
4 outer surface corresponding to the bore of said first part, and said eccentric sleeve including a bore
5 which is parallel to and not coaxial with the outer surface of the eccentric sleeve; and
6 a second part comprising a pin corresponding to the bore in said eccentric sleeve, said pin
7 for insertion in the bore in said eccentric sleeve.

8 2. The apparatus of claim 1, further comprising:
9 a securing means passing through said first part, the securing means for contacting the outer
10 surface of said eccentric sleeve.

11 3. The apparatus of claim 2, further comprised of said securing means comprising a set
12 screw passing through said first part.

13 4. The apparatus of claim 2, further comprised of said securing means comprising:
14 a ball member for contacting the outer surface of said eccentric sleeve; and
15 a set screw passing through said first part, with an end of said set screw contacting said ball
16 member.

1 5. The apparatus is claimed in claim 2, further comprised of said first part comprising a
2 piston, and said second part further comprising a seal tube, with an end of said pin for insertion in
3 said seal tube.

4 6. The apparatus of claim 1, further comprised of said first part comprising a piston, and said
5 second part further comprising a seal tube, with an end of said pin for insertion in said seal tube.

6 7. An apparatus, comprising:
7 a first part including a bore;
8 a sleeve mounted in said bore of said first part, said sleeve including an outer surface
9 corresponding to the bore of said first part, and said sleeve including a bore; and
10 a second part comprising a pin corresponding to the bore in said sleeve, said pin for insertion
11 in the bore in said sleeve.

12 8. The apparatus of claim 7, further comprising:
13 a securing means passing through said first part, said securing means for contacting the
14 outer surface of said sleeve.

15 9. The apparatus of claim 8, further comprised of said securing means comprising a set

2 screw passing through said first part.

1 10. The apparatus of claim 8, further comprised of said securing means comprising:
2 a ball member for contacting the outer surface of said sleeve; and
3 a set screw passing through said first part, with an end of said set screw contacting said ball
4 member.

11. The apparatus of claim 8, further comprised of said first part comprising a piston, and
said second part further comprising a seal tube, with an end of said pin for insertion in said seal tube.

12. The apparatus of claim 7, further comprised of said first part comprising a piston, and
said second part further comprising a seal tube, with an end of said pin for insertion in said seal tube.

1 13. An apparatus, comprising:
2 a mount;
3 a piston adjacent to said mount, said piston being of a shape for defining a movement
4 direction of the piston;
5 a shear pin with one end of the shear pin press fit in an aperture in said mount and an another
6 end of the shear pin inserted in an aperture in said piston, for restraining the piston relative to the
7 mount;
8 a hammer region formed on said piston and located in a direction of motion of said piston;

9 and

10 a strikable part mounted in the direction of motion of the piston from said hammer region
11 and separated from the hammer region by a gap, said hammer region for striking said strikable part
12 upon movement of the piston in the direction of motion through said gap.

1 14. The apparatus of claim 13, further comprised of said strikable part being mounted to said
2 mount.

15. The apparatus of claim 13, further comprising:
a stationary part connected to said strikable part by a shearable link, said strikable part for
being separated from said stationary part upon being struck by said hammer region with an input
force for shearing said shearable link.

1 16. The apparatus of claim 15, further comprised of:
2 said stationary part being connected to said mount.

1 17. The apparatus of claim 15, further comprised of said shear pin being constructed to be
2 shearable with less input force than the input force for shearing said shearable link.

1 18. An apparatus, comprising:
2 a mount;

3 a piston adjacent to said mount, said piston being of a shape for defining a movement
4 direction of the piston;

5 a shear pin with one end of shear pin inserted in an aperture in said mount and another end
6 of the shear pin inserted in an aperture in said piston, for restraining the piston relative to the mount;

7 a hammer region formed on said piston and located in a direction of motion of said piston;
8 and

9 a strikable part mounted in the direction of motion of the piston from said hammer region
10 and separated from the hammer region by a gap, said hammer region for striking said strikable part
11 upon movement of the piston in the direction of motion through said gap, and said shear pin being
12 positioned in spaced relation from said strikable part in the direction of motion of said piston.

13 19. The apparatus of claim 18, further comprised of said strikable part being mounted to said
14 mount.

15 20. The apparatus of claim 18, further comprising:

16 a stationary part connected to said strikable part by a shearable link, said strikable part for
17 being separated from said stationary part upon being struck by said hammer region with an input
18 force for shearing said shearable link.

19 21. The apparatus of claim 20, further comprised of:

20 said stationary part being connected to said mount.

1 22. The apparatus of claim 20, further comprised of said shear pin being constructed to be
2 shearable with less input force than the input force for shearing said shearable link.

1 23. An apparatus, comprising:
2 a mount;
3 a piston adjacent to said mount, said piston being of a shape for defining a movement
4 direction of the piston;
5 a shear pin with one end of the shear pin inserted in an aperture in said mount and another
6 end of the shear pin connected to said piston through a sleeve, for restraining the piston relative to
7 the mount;
8 a hammer region formed on said piston and located in a direction of motion of said piston;
9 and
10 a strikable part mounted in the direction of motion of the piston from said hammer region
11 and separated from the hammer region by a gap, said hammer region for striking said strikable part
12 upon movement of the piston in the direction of motion through said gap.

1 24. The apparatus of claim 23, further comprised of said strikable part being mounted to said
2 mount.

1 25. The apparatus of claim 23, further comprising:

2 a stationary part connected to said strikable part by a shearable link, said strikable part for
3 being separated from said stationary part upon being struck by said hammer region with an input
4 force for shearing said shearble link.

1 26. The apparatus of claim 25, further comprised of:

2 said stationary part being connected to said mount.

27. The apparatus of claim 25, further comprised of said shear pin being constructed to be
shearable with less input force than the input force for shearing said shearable link.

28. The apparatus of claim 25, further comprised of said sleeve being an eccentric sleeve,
said eccentric sleeve including a bore for receiving said shear pin which is parallel to and not coaxial
with an outer surface of said sleeve.

1 29. The apparatus of claim 23, further comprised of said sleeve being an eccentric sleeve,
2 said eccentric sleeve including a bore for receiving said shear pin which is parallel to and not coaxial
3 with an outer surface of said sleeve.

1 30. A pyrovalve, comprising:

2 a housing including a bore;

3 a pyrotechnic initiator mounted in an upper portion of said housing;

4 a seal tube mounted in and extending out from said housing, with an axis of the seal tube
5 being positioned perpendicular to an axis of the bore of said housing, said seal tube further
6 comprising a shearable cap on an end of said seal tube located inside the housing;

7 a piston located inside in the bore of said housing so as to define a direction of motion for
8 the piston, said piston comprising:

9 a hollow formed in a side of the piston, said hollow for receiving said shearable cap, said
10 hollow being larger in cross-section than the shearable cap so as to define a gap between an overhang
11 of the piston and said shearable cap; and

12 a shear pin connecting said shearable cap to said piston through a sleeve, for restraining play
13 in said piston.

31. The pyrovalve of claim 30, further comprising:

a first portion of said shear pin for insertion into an aperture in said shearable cap;

3 said piston including a bore for surrounding said sleeve including a second portion of the
4 shear pin not located in said aperture of the shearable cap;

5 said sleeve for insertion into the bore of said piston, said sleeve including an outer surface
6 corresponding to said bore of said piston, and said sleeve including a bore corresponding to the
7 second portion of the shear pin and oriented parallel to and not coaxial with the outer surface of the
8 sleeve; and

9 said second portion of said shear pin for insertion into said bore of said sleeve.

1 32. A pyrovalve, comprising:

2 a housing including a bore;

3 a pyrotechnic initiator mounted in an upper portion of said housing;

4 a seal tube mounted in and extending out from said housing, with an axis of the seal tube
5 being positioned perpendicular to an axis of the bore of said housing, said seal tube further
6 comprising a shearable cap on an end of said seal tube located inside the housing;

7 a piston located inside in the bore of said housing so as to define a direction of motion for
8 the piston, said piston comprising:

9 a hollow formed in a side of the piston, said hollow for receiving said shearable cap, said
10 hollow being larger in cross-section than the shearable cap so as to define a gap between an overhang
11 of the piston and said shearable cap; and

12 a shear pin press fit in an aperture of said shearable cap and for being coupled to said piston,
13 for restraining play in said piston.

1 33. The pyrovalve of claim 32, further comprising:

2 a first portion of said shear pin for insertion into an aperture in said shearable cap;

3 said piston including a bore for surrounding a second portion of the shear pin not located in
4 said aperture of the shearable cap;

5 a sleeve for insertion into the bore of said piston, said sleeve including an outer surface
6 corresponding to said bore of said piston, and said sleeve including a bore corresponding to the
7 second portion of the shear pin and oriented parallel to and not coaxial with the outer surface of the

8 sleeve; and

9 said second portion of said shear pin for insertion into said bore of said sleeve.

1 34. The pyrovalve of claim 32, further comprising:

2 a first portion of said shear pin for insertion into an aperture in said shearable cap;

3 said piston including a bore for surrounding a second portion of the shear pin not located in
4 said aperture of the shearable cap;

5 a sleeve for insertion into the bore of said piston, and said sleeve including a bore
6 corresponding to the second portion of the shear pin; and

7 said second portion of said shear pin for insertion into said bore of said sleeve.

8 35. A method for restraining free play in an apparatus, comprising the steps of:

9 providing a first part including a bore;

10 mounting a sleeve in said bore of said first part, said sleeve including an outer surface
11 corresponding to said bore of said first part, and said sleeve including a bore;

12 inserting a pin into the bore in said sleeve.

13 36. The method of claim 35, further comprising the steps of:

14 passing a securing means through said first part; and

15 contacting an outer surface of said sleeve by said securing means to restrain free play in said
16 first part.

1 37. The method of claim 37, further comprising the steps of:

2 providing a second part; and

3 inserting an end of said pin into said second part, to restrain free play in said first part.

1 38. The method of claim 35, further comprising the steps of:

2 providing a second part; and

3 inserting an end of said pin into said second part, to restrain free play in said first part.

1 39. The method of claim 38, further comprising the step of:

2 press fitting into a bore of said second part an end of said pin, and a coupling said second part to said
3 first part through said pin.

1 40. The method of claim 35, further comprised said bore of said sleeve being parallel to and

2 not coaxial with the outer surface of said sleeve.

1 41. A method for restraining free play, comprising the steps of:

2 providing a first part including a bore;

3 providing a second part including a bore;

4 press fitting a pin into said bore of said second part; and

5 coupling said first part to said second part through said pin.

1 42. A method for restraining free play in an apparatus, comprising the steps of:

2 providing a mount;

3 providing a piston adjacent to the mount, said piston being of a shape for defining a
4 movement direction of the piston; and

5 inserting an end of a shear pin into an aperture in the mount and connecting another end of
6 the shear pin to the piston through a sleeve to couple said mount to said piston, for restraining the
7 piston relative to the mount.

8 43. The method of claim 42, further comprising the steps of:

9 with said piston being restrained relative to the mount, striking a strikable part with a hammer
10 region formed on the piston in a direction of motion of the piston by traversing the piston through
11 a gap separating the hammer region from the strikable part.

12 44. The method of 43, further comprising the step of:

13 separating the strikable part from a stationary part upon being struck by the hammer region
14 of the piston.

15 45. The method of claim 44, further comprising the step of:

16 shearing the shear pin by motion of the piston.

1 46. The method of claim 42, further comprising the step of:

2 shearing the shear pin by motion of the piston.

1 47. A method for the restraining free play in an apparatus, comprising the steps of:

2 providing a mount;

3 providing a piston adjacent to the mount, the piston being of a shape for defining a movement
4 direction of the piston; and

5 press fitting an end of a shear pin into the mount and coupling the other end of the shear pin
6 to said piston, for restraining the piston relative to the mount.

7 48. The method of claim 47, further comprising the step of:

8 with the piston restrained relative to the mount, striking a strikable part mounted in the
9 direction of motion of the piston by a hammer region formed on the piston by moving the piston
4 through a gap separating the hammer region and the strikable part.

1 49. The method of claim 48, further comprising the step of:

2 separating the strikable part from a stationary part upon being struck by the hammer region.

1 50. The method of claim 49, further comprising the step of:

2 shearing the shear pin by motion of the piston.